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## EUROPEAN PATENT APPLICATION

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⑤④ Apparatus and method for anodic treatment.

⑤⑦ A method for anodic surface treatment of metal surfaces comprising the steps of providing a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid, positioning at least first and second electrodes in the treatment container, applying AC electrical current across the electrodes and causing a metal element to be located in the treatment container during application of the AC electrical current across the electrodes.

DC surface treatment is also described.

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## FIELD OF THE INVENTION

The present invention relates to methods and apparatus for surface treatment of metal surfaces and more particularly to surface treatment which enhances adhesion and prevents blistering of organic coatings applied thereto.

## BACKGROUND OF THE INVENTION

The importance of surface passivation in the canning industry is described in detail in applicant's issued U.S. Patent 4,448,475; there is provided a method of anodically treating a tinned metal surface prior to coating with an organic coating so as to increase the long-term adhesion of the organic coating to the tinned metal surface and comprising the step of placing the tinned metal surface in an electrolyte bath wherein the electrolyte comprises one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, and dilute nitric acid.

Applicant's U.S. Patent 4,448,475 recommends the provision of a direct anodic electrical connection to the metal surface to be treated and the placement of anodes in the treatment solution. It indicates the possibility of treatment also without such electrical connections.

## SUMMARY OF THE INVENTION

The present invention seeks to provide a highly efficient and cost effective technique for surface treatment of metals. This treatment may be applied advantageously to any metal surface for enhancing the adhesion of coating thereon and may be applied simultaneously with other treatments, when suitable.

There is thus provided in accordance with a preferred embodiment of the present invention, a method for anodic surface treatment of metal surfaces comprising the steps of providing a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid, positioning at least first and second electrodes in the treatment container, applying AC electrical current across the electrodes and causing a metal element to be located in the treatment container during application of the AC electrical current across the electrodes.

There is also provided in accordance with an embodiment of the present invention, apparatus for surface treatment of metal surfaces comprising a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid, at least first and second electrodes disposed in the treatment container, means for

applying AC electrical current across the electrodes and means for causing a metal element to be located in the treatment container during application of the AC electrical current across the electrodes.

According to a preferred embodiment of the invention, the metal element comprises a web of metal, such as rolled plate steel, tinned or untinned, and there are provided electrodes adjacent both sides of the web to provide treatment of both metal surfaces.

Further in accordance with a preferred embodiment of the invention, the AC electrical current is provided at line voltage or higher and at a frequency of the mains, e.g. 60 Hz.

Additionally in accordance with an embodiment of the invention, the treatment solution can be a tin plating solution such as a tin salt solution such as sodium stannate  $\text{Na}_2\text{SnO}_3$ . In such a way, the surface treatment may occur simultaneously with a tin coating step.

Further in accordance with an embodiment of the invention, the metal element may be maintained uncoupled to a fixed source of electrical potential and thus "floating". In this embodiment, non-conductive rollers may be employed for feeding and guiding coil of metal to be treated.

There is also provided in accordance with a preferred embodiment of the present invention, a method for anodic surface treatment of metal surfaces comprising the steps of providing a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute

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nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid, positioning at least first and second electrodes in the treatment container applying DC electrical current across the electrodes at a voltage in excess of Volts, and causing a metal element to be located in the treatment container during application of the AC electrical current across the electrodes.

## BRIEF DESCRIPTION OF THE DRAWING

The present invention will be understood and appreciated more fully from the following detailed description taken in conjunction with the drawing in which:

Fig. 1 is a side view illustration of apparatus for surface treatment constructed and operative in accordance with a preferred embodiment of the present invention.

## DETAILED DESCRIPTION OF THE INVENTION

Reference is now made to Fig. 1 which illustrates apparatus for surface treatment constructed and operative in accordance with a preferred embodiment of the invention. There is seen in Fig. 1, a strip of sheet metal 10, such a tinplate or uncoated steel, disposed in a bath 12 containing a treatment solution 14. The sheet metal is typically left "floating", not being coupled to a source of electrical potential and thus may be guided by ordinary non-conductive rollers 16, which may be formed of rubber or of any other suitable material.

A plurality of electrodes 18, typically four in number, is disposed in bath 12. The electrodes are normally distributed so as to lie adjacent both surfaces of the sheet metal 10, so as to provide treatment of both of these surfaces.

According to one embodiment of the invention, AC current is applied across one or both pairs of electrodes A,B and

C,D. According to an alternative embodiment of the invention, DC current is used. If for example the C electrode is coupled to a positive voltage and the D electrode is coupled to a negative voltage, the metal surface facing the D electrode, i.e. the negative electrode, receives the surface treatment.

Should one wish to provide surface treatment of the opposite metal surface, one can switch the polarity of the C and D electrodes or employ the A and B electrodes in a suitable polarity arrangement. Should surface treatment of both surfaces be desired, then both pairs of electrodes are employed in suitable polarity connections.

According to a preferred embodiment of the invention, electrical current of 5 - 150 Amps at a voltage of 12 - 500 Volts and a frequency of 60 - 440 Hz is supplied by a suitable power supply 20 or directly from the mains across the electrodes.

The metal sheet may be fed through the bath at a typical speed of 600 meters per minute so as to have a typical dwell time of 0.05 - 0.5 seconds.

#### EXAMPLE I

Using 1.5 Aluminum nitrate treatment solution and an applied current at 110 Volts AC, the current density was about 30 Amp. per sq. decimeter over a dwell time of 0.1 second. Efficient surface treatment was obtained.

#### EXAMPLE II

Under the same conditions as in Example I, a treatment solution of 1:2 stannate industrial tinning solution was employed, providing efficient surface treatment.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined only by the claims which follow:

## CLAIMS

1. A method of anodic surface treatment of metal surfaces comprising the steps of:

providing a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid;

positioning at least first and second electrodes in the treatment container;

applying AC electrical current across the electrodes;  
and

causing a metal element to be located in the treatment container during application of the AC electrical current across the electrodes.

2. Apparatus for anodic surface treatment of metal surfaces comprising:

a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid,

at least first and second electrodes disposed in the treatment container;

means for applying AC electrical current across the electrodes; and

means for causing a metal element to be located in the treatment container during application of the AC electrical current across the electrodes.

3. Apparatus according to claim 2 and wherein said metal element comprises a web of metal.

4. Apparatus according to claim 2 and wherein said metal element comprises untinned steel.

5. Apparatus according to claim 2 and wherein said means for applying AC electrical current includes means for providing AC electrical current at line voltage or higher and at a frequency of the mains.

6. Apparatus according to claim 2 and wherein said metal element is maintained uncoupled to a fixed source of electrical potential.

7. A method for anodic surface treatment of metal surfaces comprising the steps of:

providing a treatment container containing a treatment solution comprising one or more of the following substances: tap water, dilute nitrate salts, dilute hydrochloric acid, dilute nitrite salts, dilute sulfuric acid, stannous and stannic salts and dilute nitric acid;

positioning at least first and second electrodes in the treatment container;

applying DC electrical current across the electrodes at a current density at the substrate of between 8 - 50 Amps per sq. decimeter; and

causing a metal element to be located in the treatment container during application of the DC electrical current across the electrodes.

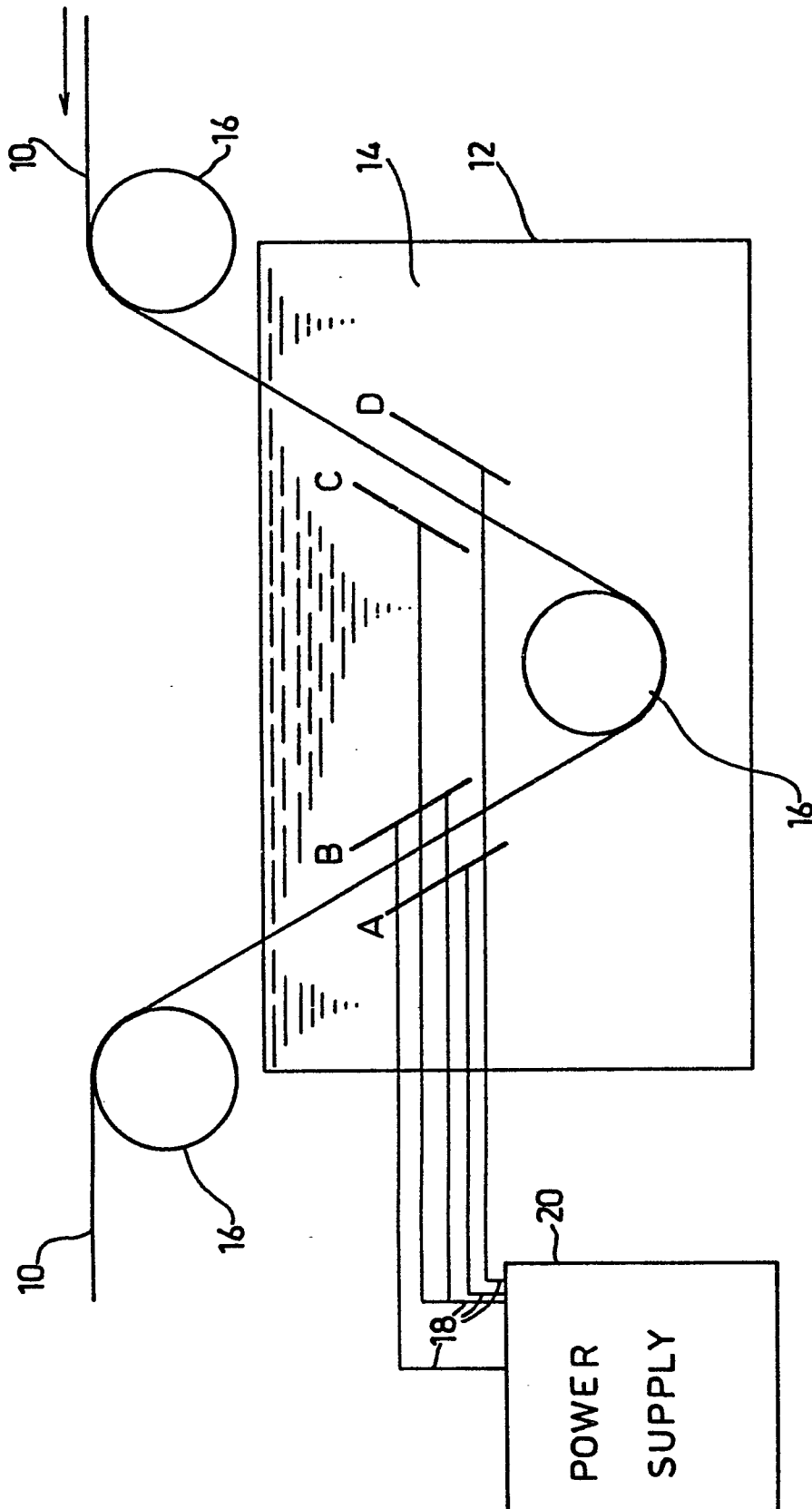


FIG 1



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# EUROPEAN SEARCH REPORT

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                 |                                  | EP 86303710.7                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------------------------------------------------------------------|
| Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Citation of document with indication, where appropriate, of relevant passages                                                                                                                                                                   | Relevant to claim                | CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)                               |
| D, X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <p>US - A - 4 448 475 (D. REZNICK)</p> <p>* Claims *</p> <p>--</p>                                                                                                                                                                              | 1, 7                             | <p>C 25 F 1/06</p> <p>C 25 F 7/00</p> <p>C 25 D 11/02</p> <p>C 25 D 7/06</p> |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>DE - A1 - 2 646 697 (NATIONAL STEEL CORP.)</p> <p>* Fig. 2,4; page 9, line 9 *</p> <p>--</p>                                                                                                                                                 | 2, 4                             |                                                                              |
| X                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>DE - A - 1 496 808 (GENERAL DYNAMICS CORP.)</p> <p>* Fig. 3; page 1, lines 1-4; page 13, lines 26-28 *</p> <p>--</p>                                                                                                                         | 2, 4, 5                          |                                                                              |
| A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p>PATENT ABSTRACTS OF JAPAN, unexamined applications, C field, vol. 8, no. 193, September 5, 1984</p> <p>THE PATENT OFFICE JAPANESE GOVERNMENT</p> <p>page 94 C 241</p> <p>* Kokai-no. 59-85 893 (SHIN NIPPON SEITETSU K.K.) *</p> <p>----</p> | 2                                | <p>TECHNICAL FIELDS SEARCHED (Int. Cl. 4)</p> <p>C 25 F</p> <p>C 25 D</p>    |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                 |                                  |                                                                              |
| Place of search                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                 | Date of completion of the search | Examiner                                                                     |
| VIENNA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                 | 14-08-1986                       | SLAMA                                                                        |
| <p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone</p> <p>Y : particularly relevant if combined with another document of the same category</p> <p>A : technological background</p> <p>O : non-written disclosure</p> <p>P : intermediate document</p> <p>T : theory or principle underlying the invention</p> <p>E : earlier patent document, but published on, or after the filing date</p> <p>D : document cited in the application</p> <p>L : document cited for other reasons</p> <p>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                                                                                                                                                 |                                  |                                                                              |